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The Iraqi Chemical Weapons Program in Perspective

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An Intelligence Assessment

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January 1985

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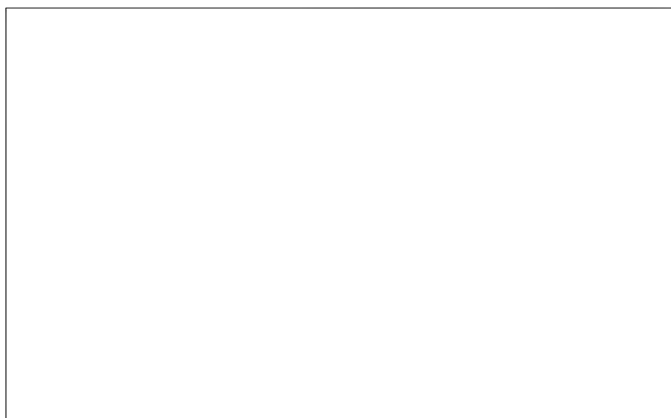
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The Iraqi Chemical Weapons Program in Perspective

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**The Iraqi Chemical Weapons
Program in Perspective**

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Key Judgments

*Information available
as of 15 November 1984
was used in this report.*

The successful use of lethal chemical weapons by Iraq in a conventional war is the culmination of 20 years of effort by Baghdad to acquire or develop such weapons. The past decade has witnessed the success of their sustained and systematic effort to develop a state-of-the-art capability to manufacture chemical weapons against great political odds and despite economic sanctions in acquisition of requisite technology. The chemical warfare program has been a relatively cheap investment for Iraq. We estimate the program has cost slightly above \$200 million in capital expenditures during the past decade, less than 2 percent of Iraq's military expenditures over the same period. The program occupies about the same order of magnitude in dollars and research and development effort as the Iraqi nuclear program.

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Iraq has managed to obtain needed assistance in research, training, and process technology from Soviet, West European, and other Middle Eastern sources. Without this foreign, particularly West European, assistance, we believe the Iraqis could not have developed chemical weapons. Help by the West German firm [] has been especially critical [] supplied technical expertise and equipment and has facilitated Iraqi contacts with other West European suppliers. Despite their continuing heavy involvement in Iraq's chemical protective programs, we do not believe that the Soviets have been involved in the Iraqi effort to develop chemical weapons since the mid-1970s. At that time, the Iraqis excluded the Soviets from the Iraqi weapons program because of their dissatisfaction with Soviet prices and equipment and because the Iraqis had adequate support from West European firms.

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We believe Iraq has made sufficient progress in its chemical weapons program to render it relatively immune from foreign pressures. US efforts to embargo Western equipment and precursor chemicals will slow the Iraqi chemical warfare program and impose greater costs but probably will not halt Iraq's progress. Most production equipment is in place. Iraq is using numerous front companies and friendly Arab states to circumvent the Western embargo on precursor chemicals. Moreover, if the Western embargo proves effective and Iraq's ability to procure supplies in Western Europe is ended, we believe the Iraqis could, with partial success, once again turn to the Soviet Union and Eastern Europe for supplies of all but finished agent.

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Chemical warfare probably will play an increasingly important role in the Iran-Iraq war. The Iraqis have successfully used chemical weapons in three separate battles beginning in August 1983 and will use chemical weapons on a wide scale in the event of another major Iranian attack. As Iraq acquires a larger stockpile of chemical weapons and more experience in their use, it will become extremely difficult for Iran to mount large-scale attacks against Iraqi territory. As a result, we believe Iran is making a major effort to develop its own chemical weapons.

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We estimate the Iraqis have a stockpile of several thousand bombs and artillery shells filled with mustard agent. They also probably have a few hundred bombs filled with the nerve agent tabun. By late 1985, this stockpile should increase significantly, barring only an Israeli airstrike on its main production facility. We estimate Iraq is capable of producing a maximum of 3 to 6 metric tons of mustard agent and 1 to 2 tons of tabun per day at its main production facility at Samarra. Sarin, a second-generation nerve agent, also is being produced in unknown quantity. The production rate for mustard and tabun at the research and development facility at Salman Pak is unknown but is clearly less than at Samarra.

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The Iraqis have been careful to use chemical weapons only when the Iranians were on Iraqi territory. We believe Iraq will show restraint in using chemical weapons outside its borders, particularly against states such as Israel or Syria, which have chemical weapons stockpiles and adequate protective equipment of their own

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The publicity accompanying Iraq's use of chemical weapons and their relative cost-effectiveness probably will spur other Third World countries to develop chemical weapons. Iraq probably would be willing to provide chemical weapons or technology to friendly Arab states, although some countries, Jordan and Saudi Arabia in particular, would be unlikely to seek such weapons. [REDACTED]

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The lack of success in stopping the Iraqi program suggests that efforts to halt foreign chemical weapons programs must be taken early in the development phase. Once major equipment is delivered, the Iraqi experience suggests suppliers will forestall effective controls until their involvement in the program is completed. [REDACTED]

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The Iraqi Chemical Weapons Program in Perspective

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Origins and Motivations

The Iraqi chemical warfare program originated in 1961 with the establishment of a chemical defense school. In 1964 Iraq established a Chemical Corps as a separate branch of the Army. The effort to acquire chemical weapons has since then been motivated by Baghdad's perception of military threats, particularly from Israel and Iran, and also by Iraq's desire to play a major role in the Middle East. The ongoing war with Iran has provided a major impetus for the continuation and acceleration of the program. Baghdad's initial focus was on establishing a chemical warfare protective program, obtaining equipment and training from the USSR, and developing tactical plans for offensive use of riot control agents.

and Syria also were trying to acquire chemical weapons. We believe Iraqi military leaders were aware of these programs and efforts; and their interest in acquiring CW weapons was partially driven by the existence of these programs. By 1968 Iraqi planning for the development of a full-scale agent production program, measures to obtain precursor chemicals, and the purchase of additional protective equipment from the USSR were under way.

a military study completed in 1970 recommended that a center for chemical weapons production be established under the Ministry of Defense and that the necessary raw materials be obtained for full-scale manufacture of chemical defense agents.

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The earliest known reference to Iraqi plans to produce chemical weapons occurred in 1966.

By 1972 a research and development effort on chemical warfare was begun at the Iraqi Engineering Research Institute under Soviet direction. The Soviets provided equipment as well as training for Iraqi engineers. Small amounts of the nerve agent tabun and other chemical agents were produced for experimental purposes. By the early 1970s the Soviets also had begun providing large quantities of modern chemical warfare defensive equipment to the Iraqi Army.

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Following the 1967 Arab-Israeli war, Iraq began to perceive a chemical weapons threat from Israel, even though no chemical weapons were used during the fighting.

By the mid-1970s, political stability and the end of the Kurdish rebellion freed Baghdad to devote major efforts to long-range planning in a variety of fields including chemical warfare.

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many other important Iraqi programs also began in the mid-1970s including a major conventional arms buildup, establishment of a significant domestic arms industry, the Iraqi nuclear program, and many large economic development projects.

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Director of Military Intelligence estimated that Israel had chemical weapons and that Iraq therefore needed to develop chemical weapons as a deterrent. Moreover, the Iraqis concluded that Israel would be a "good" target for Iraqi chemical weapons and they decided to make inquiries worldwide to determine if chemical weapons were commercially available.

At the same time, in our judgment, Iraqi motivations to pursue a chemical warfare program were growing stronger. Iraq's poor performance during the 1973 Arab-Israeli war—its first real exposure to sustained

Moreover, the USSR and the United States were aggressively pursuing development of chemical weapons in the 1960s. Other Arab countries such as Egypt

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conventional combat—and its expressed desire to play a larger role in any future conflict with Israel sparked an across-the-board effort to improve military capabilities. Moreover, Iran, Baghdad's other potential military opponent, also began a major arms buildup in the mid-1970s. As Iran modernized its armed forces, Iraqi leaders publicly expressed concern that they were falling behind and began a major arms buildup of their own. In addition, the oil price hikes following the 1973 Arab-Israeli conflict provided Iraq with increased revenues with which to pursue its military buildup, including its chemical warfare program. Oil provided it with the economic leverage and revenues to gain access to Western technology that normally might have been restricted by suppliers [redacted]

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Program Development

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[redacted] Iraqi leaders decided in 1973 to develop a full-scale chemical weapons program. The following year the chemical warfare program was transferred from the intelligence section of the ruling Ba'th Party to an ostensibly civilian organization, the General Engineering Services. A research and development project was established through two front organizations, the Al Hazen Institute and the Al Hasan Bin Haytham Foundation. The institute and foundation acted as cover organizations for contact with Western commercial firms to acquire specialized engineering and equipment to begin a research and development effort. They also made the initial contacts with West European commercial firms for construction of a central facility to produce chemical weapons [redacted]

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By late 1974 Iraq obtained critical production components from French and British firms and agent precursor chemicals from a Swiss company for the manufacture of small quantities of mustard agent. We believe this equipment was installed at a research and development facility at Salman Pak about 20 kilometers (km) south of Baghdad. Construction on this facility began in early 1975 and the installation probably was operational by mid-1977 [redacted]

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Construction of a full-scale production complex also began in 1975 about 70 km northwest of Baghdad near the town of Samarra [redacted]

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[redacted] the Samarra site is the central installation for the Iraqi program to produce chemical warfare agents. The SAAD (expansion unknown) General Establishment is responsible for supervising construction of this facility. SAAD is subordinate to the State Organization for Technical Industries (SOTI) and both are ostensibly civilian organizations run by the Ministry of Industry. SOTI is an umbrella organization set up to supervise Iraqi arms industry projects and is directly subordinate to the Director for Military Industries in the Ministry of Defense. In 1980 the director of SOTI was an Iraqi Army general [redacted]

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In 1978 direction of the program was shifted to the Directorate of Chemical Warfare in the Ministry of Defense (see figure 1). Two years later the State Establishment for Pesticide Production (SEPP) associated with the Ministry of Chemical Industries was created as a cover organization to run the facility and obtain precursor chemicals for actual chemical agent production [redacted]

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[redacted] with the large-scale involvement of West European, particularly West German, firms in the program during the mid-1970s Baghdad began to phase out the limited Soviet involvement in the program. A Soviet engineering delegation arrived in late 1976 to negotiate a contract on the design and construction of a central laboratory for chemical warfare agent manufacture. The Iraqis, however, terminated the negotiations because of problems with price and equipment specifications and Iraqi fears that the Soviets would provide obsolete equipment. Moreover, with construction on the Samarra complex under way, Baghdad did not need the Soviets. In 1978, the USSR refused to provide Iraq with nerve agent samples that the Iraqis wanted to establish production and quality standards. The refusal seems to have severed direct Soviet involvement in the Iraqi program to produce chemical weapons, although the Soviets remain heavily involved in Iraqi efforts to acquire defensive chemical equipment [redacted]

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**Milestones in Iraq's Development
of Chemical Weapons**

1961	Chemical defense school established.	1976	Iraqis terminate negotiations with Soviets for design and construction of a production complex.
1964	Iraqi Chemical Corps established as a separate branch of Army service.		
1966	Iraq requests Arabs explore feasibility of supplying it with chemicals to develop toxic agents.	1977	Salman Pak Pilot Plant complete and operational.
		1978	Soviets refuse to supply nerve agent samples.
1968	Director of Iraqi Military Intelligence recommends development of chemical weapons for use against Israel.	1980	Samarra facility largely complete but insufficient equipment available for large-scale production.
1970	Military study recommends establishing a research center for producing chemical weapons.	1981-82	Contracts with West German firms to install additional equipment at Samarra. Iraq uses nonlethal chemical agents against Iranians.
1972	Research and development effort begun at the Iraqi Engineering Institute. Small amounts of tabun produced under Soviet direction.	1983	Iraq uses mustard agent against Iran on a limited scale.
1974	Iraq obtains critical components from French and British firms and precursor chemicals from Swiss.	1984	Iraq makes widespread use of mustard agent and limited use of the nerve agent tabun against Iranian forces near Al Basrah.
1975	Construction begins at Salman Pak research and development facility and on the full-scale production complex at Samarra. Retired Egyptian general hired to head effort.		

A decision to upgrade and expand the production program resulted in 1981 and 1982 contracts with West German firms for more equipment and engineering services.

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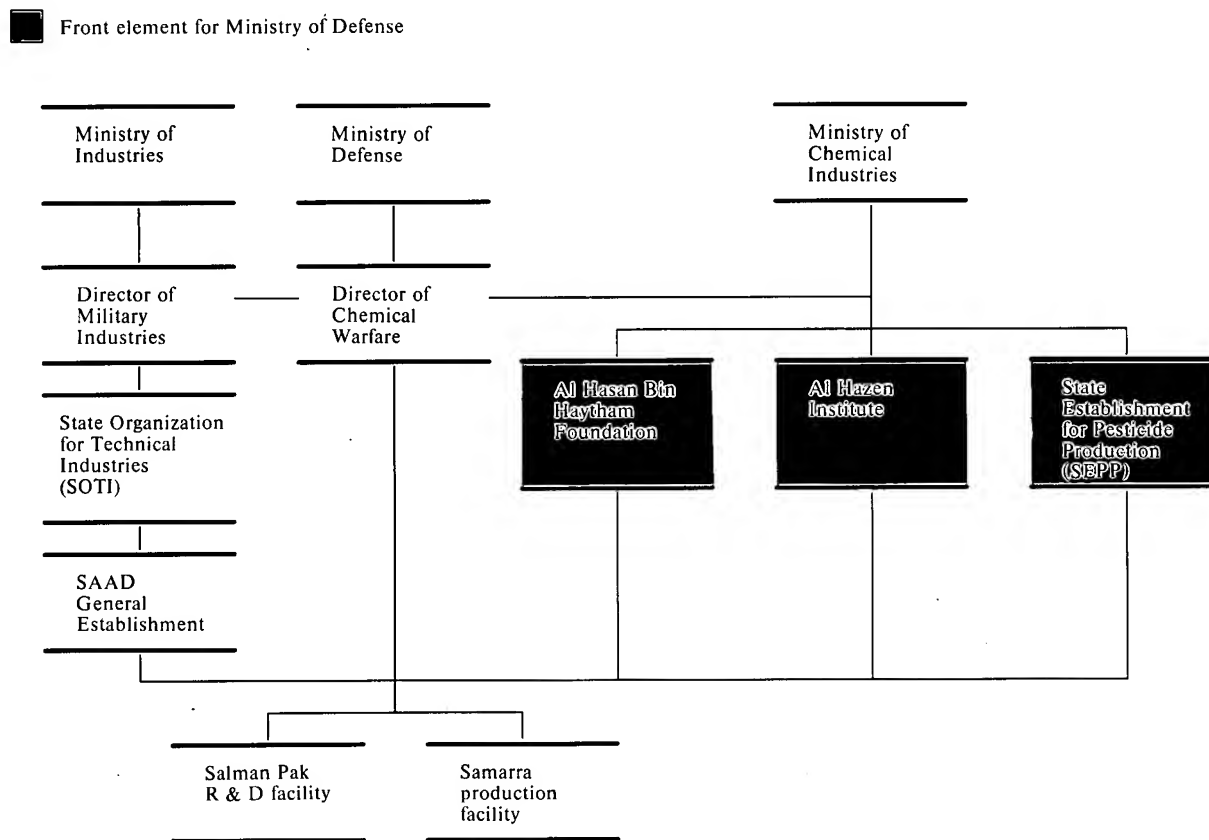
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Figure 1
Iraqi Organizations for Chemical Warfare Production



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ordered by SEPP indicate the Iraqis are using these patented processes in their chemical weapons effort.

The Iraqis also contracted for several chemical laboratories from the Swiss to produce tabun during July 1982. We believe the tabun equipment was installed in the Samarra facility. Despite some early developmental problems, this equipment has now been

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Blister and Nerve Agents

Blister agents are used primarily to cause medical casualties. They may also be used to restrict use of terrain, to slow movements, and to hamper use of material and installations. These agents affect the eyes and lungs and blister the skin. During World I mustard was the only blister agent in major use. It was recognized by a distinctive odor and had a fairly long duration of effectiveness under normal weather conditions. Since then, blister agents have been developed that are odorless and that vary in duration of effectiveness. The development of casualties can be delayed up to 24 hours. Protection from blister agents is extremely difficult. We believe some of the mustard being used by Iraq is in a dry or powder form in a silicate mixture and is more rapid acting and more effective in causing injury and/or death.

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Nerve agents denote a class of chemical compounds that disrupt the nerve impulse transmission in the body. These gases, such as tabun and sarin, are extremely rapid acting (within minutes) and may be absorbed through the skin or through the respiratory tract. The appearance of symptoms is faster for absorption through the respiratory tract than through the skin. Some of the symptoms for nerve gas poisoning are pin-pointing of the pupils, tightness in the chest, sweating, nausea, diarrhea, easy fatigue, and muscular twitching. Deaths from nerve gas poisoning can be attributed to respiratory and circulatory failure. Nerve gas is used to create a short-term respiratory hazard on the battlefield.

Details of traditional chemical warfare agents are shown in the following tabulation:

Common Name	Mustard	Tabun	Sarin
Symbol	HD	GA	GB
State at 20° C	Pale yellow liquid	Colorless liquid	Colorless liquid
Duration of hazard	12 to 14 hours ^a 2 to 7 days ^b	11 to 13 hours ^c 11 to 13 hours ^c	0.25 to 1 hour 0.25 to 4 hours
Rate of action	Delayed, hours to days	Very rapid, minutes	Very rapid, minutes
Physiological action	Blisters, destroys tissue, injury to blood vessels, and may cause death with sufficient concentration.	Cessation of breathing	Cessation of breathing
Weapon systems	Shells and bombs	Shells and bombs	Shells and bombs
Use	Delayed action casualty agent	Quick-action casualty agent	Quick-action casualty agent

^a 10° C, rainy, moderate wind.

^b 15° C, sunny, light breeze.

^c Estimated.

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brought on line to give the Iraqis a tabun production capability (they used tabun against the Iranians in March 1984).

the Iraqi chemical warfare program immediately traveled to Egypt to meet with his counterparts in the Egyptian chemical warfare program for assistance in producing tabun. The visit of an Egyptian delegation to the Samarra facility in early 1983 leads us to believe the Egyptians provided Iraq with the requested assistance.

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The early developmental problems surfaced when, in November 1982, the Iraqis fired shells containing locally produced tabun at animal targets and the tests were unsuccessful. The Iraqis concluded that their manufacturing process for tabun was incorrect and the chemical formulation was at fault. The director of

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Production Capability and Facilities

We estimate the Iraqis have a stockpile of several thousand bombs and artillery shells filled with mustard agent. They also probably have a few hundred bombs filled with the nerve agent tabun. We estimate Iraq is capable of producing 3 to 6 tons of mustard agent and 1 to 2 tons of tabun per day at its main production facility at Samarra. [redacted] Sarin is also being produced in unknown quantity. The current production rate for mustard and tabun at Salman Pak is unknown. See inset (on previous page) entitled *Blister and Nerve Agents* for details of these agents.

of expenditure. We have so far identified at least \$125 million in confirmed expenditures. Our estimate is based on Western experience in modern chemical engineering, the sophisticated operating components and elaborate toxic chemical processing equipment involved, [redacted]

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[redacted] and the costs of chemicals from a variety of sources worldwide. The Iraqi program also encompasses state-of-the-art research and development expenses, large tonnages of precursor chemicals obtained circuitously at above-market prices, and personnel services of Iraqi and foreign contractors for design, construction, and operation. Also involved are special services training, specialized maintenance, emergency services, and chemical weapons filling and handling [redacted]

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Dependency on Foreign Sources

The Iraqi chemical warfare effort is heavily dependent on foreign sources for technology, chemical defense, training, construction, equipment, and chemicals. The USSR is the main supplier of chemical defensive equipment to Iraq. West European firms have been the main suppliers of Iraq's offensive chemical warfare capability [redacted]

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The Iraqi Chemical Corps, like most of the Iraqi military, is modeled on that of the USSR. As a result, Iraq has been purchasing protective clothing, masks, decontamination equipment, and probably prophylaxis from the Soviets since the 1960s. In the early 1970s, the Soviets provided modern chemical warfare defensive equipment that we have identified at 19 military installations in Iraq. Based on special intelligence, we know the Soviets also have provided extensive defensive chemical warfare training to the Iraqi military since the 1960s. In 1983 Iraq also attempted to purchase protective garments from Western sources and investigated setting up a factory to produce gas masks and other protective equipment [redacted]

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Program Cost

We judge the chemical warfare program through mid-1984 has cost Baghdad approximately \$200 million. However, new construction at Salman Pak indicates continued expansion at an as yet undefined rate

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The training for many of the Iraqi personnel now involved in the chemical warfare program was provided by both the USSR and the Western countries. A reliable report indicates that early in the 1960s Iraqi officers were sent to the USSR and the United States for military chemical warfare training. The officers trained in the USSR received specialized chemical-biological-radiological warfare training at military schools. Some officers and many promising civilian students were sent to the USSR, the United States, and West European universities to obtain degrees in chemistry and chemical engineering. Many students received advanced degrees in organophosphorus chemistry, the area of chemistry fundamental to the development of chemical agents. The best scientists were used at the chemical warfare research and development center. The most promising military officers were used as managers for the chemical weapons program. [redacted]

West European assistance, particularly by numerous West German firms and several Swiss, Dutch, French, and Italian firms, has been critical to Iraq's efforts to develop an offensive chemical weapons capability. Indeed, without West European assistance, we believe Iraq would not have been able to develop chemical weapons on the militarily significant scale described here. [redacted]

[redacted] for example, a key player in the recent research and production effort, has been involved in the Iraqi effort to develop chemical weapons even as early as 1969. [redacted]

Agent Use in the War With Iran

Despite Iranian charges that Iraq has been using chemical weapons throughout the war, Iraq used lethal chemical weapons only in three battles beginning in August 1983 (see figure 4). The Iraqi use of mustard and nerve agents occurred in mid-March 1984. Earlier press reports that Iraq was using lethal chemical weapons appear to have been based on sporadic Iraqi use of the riot control agent CS gas ("tear gas"), white phosphorous artillery rounds, and smoke rounds. Iran has not used lethal chemical weapons during the war, but has used CS gas in isolated instances [redacted]

We assess that Iraq had only small quantities of mustard and nerve agents available when the war with Iran began. The fighting, however, spurred Iraq to speed up the program, and by 1982 Iraq had begun producing significant quantities of mustard agent. [redacted]

Iraq had accumulated approximately 1,000 artillery shells filled with mustard agent when the Iranians mounted their first invasion of Iraq in July 1982. [redacted]

In August 1983 Iraq used a limited quantity of mustard agent against Iranian troops near Haj Umran in northern Iraq. The Iraqi attacks were very limited, however, and only a handful of Iranian soldiers were seriously injured. [redacted]

On 19 November 1983 Iraq used mustard agent for a second time during a major battle near Panjwin in northern Iraq. This time the Iraqis conducted a much larger attack with chemical weapons, firing several hundred shells filled with mustard agent at Iranian forces threatening to overrun Iraqi frontline positions. We believe several hundred Iranian troops were killed or severely wounded by the mustard [redacted]

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Figure 4
Iraqi Use of Lethal Chemical Weapons in War With Iran



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[redacted]

[redacted] On 28 February Iraq made heavy use of mustard agent during a counterattack against an estimated 15,000 Iranian troops holding the western shore of the Hawizah marsh north of Al Basrah. The Iranian troops, mostly poorly trained militia and unequipped to withstand a chemical attack, broke and fled back across the marsh. According to press reports, the Iranians claim some 2,500 of their troops were killed or severely wounded by mustard agent in this attack. [redacted]

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As the battle north of Al Basrah continued, the Iraqis used mustard agent on at least two occasions in mid-March during attempts to retake the Majnoon Islands. Iran claims approximately 400 Iranian troops were killed or wounded in the two attacks. While Iraqi forces were able to advance following the first attack, their use of mustard agent was ineffective during the second assault. According to Iranian press reports, strong winds dispersed the mustard, decreasing its effectiveness. [redacted]

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On 17 March Iraq became the first country to use nerve agents against conventional military forces. An Iraqi air attack on an Iranian staging area east of the Majnoon Islands [redacted]

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Although Iraq's use of chemical weapons has caused considerable international publicity, their use has so far not been essential to Iraqi success on the battlefield. The use of tabun and mustard, however, enabled Iraqi troops to drive back the Iranians more rapidly and with fewer Iraqi casualties than might otherwise have been the case. [redacted]

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Iraq continues to stockpile nerve and mustard agent in significant quantities. Its chemical warfare capabilities probably will have a major impact on the war, especially during major offensives. Iranian infantry, particularly the poorly trained militia troops that constitute approximately half of Iran's forces at the front, are especially susceptible to chemical agent attacks. Although Iran has devoted considerable effort since March to acquiring protective chemical gear, we doubt it has sufficient quantities or that its

[redacted]

troops are sufficiently well trained to operate successfully in the face of large-scale Iraqi chemical agent attacks. [redacted]

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The Western Embargo

The Iraqi chemical warfare production program will be slowed but not stopped by the recent US decision to place precursor chemicals on the embargoed list and to convince Western suppliers to stop aiding the program. We believe the Iraqi program is so far advanced that, barring a successful airstrike on the Samarra facility, Iraq probably will have a significant stockpile of mustard and nerve agents by late 1985.

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Many West European countries have also instituted similar embargoes. Demarches to West Germany to [redacted] participation in the Iraqi chemical warfare program have produced only mixed results. We believe [redacted] nearly finished with its involvement. [redacted]

chemical warfare agents indicates Iraq's determination to continue such production. If the embargo is effective and its research efforts fail, Iraq could turn to the USSR as a last resort. [redacted]

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Possible Future Targets for Iraqi Chemical Weapons

We are unaware of Iraqi plans to employ chemical weapons after the current conflict is over. Nonetheless, there are certain observations that can be made on probable future targets for Iraqi chemical weapons based on their use in the Iran-Iraq war:

- Iraq will use chemical weapons against any invader.
- Iraq will be restrained in using chemical weapons outside its border, particularly against Israel. [redacted]

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Although the international embargo has probably made it more difficult, Iraq continues to obtain the necessary precursor chemicals, either directly or indirectly, by circumventing the embargo. [redacted]

The Iraqis have been careful to use chemical weapons during the war only when the Iranians have actually pushed across the border into Iraq or severely threatened the Iraqi defenses. With only one exception, all the known uses of lethal chemical agents have occurred against Iranian troops actually on Iraqi territory.¹ At least one senior Iraqi military officer has publicly argued that Baghdad is justified in using any weapons on its own territory to repel an invader. [redacted]

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Many different techniques have been used to circumvent the embargo. For example, a US company attempted to ship some of the precursor chemicals to Iraq, but US Customs agents stopped the shipment because of the embargo. [redacted]

This pattern suggests that Iraq will make widespread use of chemical agents against any renewed Iranian invasion. We believe Iraq will be restrained, however, in using chemical weapons outside its borders, particularly against states such as Israel or Syria, which have chemical weapons stockpiles and adequate protective equipment of their own. Iraq is not similarly restrained in using chemical weapons against Iran because the Iranians, despite a burgeoning chemical warfare effort, are as yet unable to retaliate in kind. [redacted]

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To mitigate negative effects on the CW program, in the event that Iraq cannot obtain traditional precursor chemicals in the future, research elements have begun to explore nontraditional methods of producing agents. Iraq has ordered pesticides and nonembargoed chemicals similar in structure to chemical warfare agents to determine if they could be converted to such agents. Researching alternative methods of producing

We do not have any current reliable evidence that Iraq plans to supply chemical weapons to other Arab

¹ In March of this year the Iraqis also used these weapons against Iranian staging areas and troop concentrations inside Iran near the Iraqi border which were supporting a major Iranian thrust inside Iraq. [redacted]

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states or to terrorist groups, [redacted]

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[redacted] Chemical weapons are a major new addition to the Iraqi inventory, and we believe Baghdad views these weapons as an important tactical advantage. Their use probably requires direct approval from Iraqi President Saddam Husayn. We believe Iraq also would be reluctant to provide chemical weapons to any other Middle Eastern state that someday might become a military opponent. Iraq, however, probably would be willing to provide some details on manufacturing processes and possibly samples to friendly states that have supported it during the war, such as Jordan, Egypt, or, possibly, Saudi Arabia. However, we view it unlikely that Jordan or Saudi Arabia would seek such weapons. [redacted]

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Future Prospects

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[redacted] The current Iraqi chemical warfare agent production is nearing full-scale operation. The current production facilities at Samarra for the large-scale manufacture of the vesicant mustard and sarin should be completed by the end of 1985. The Iraqis already have at least a limited capability for filling artillery shells and aerial bombs. Consequently, by the end of 1985, Iraq could have a stockpile of 2,500 to 3,000 tons of chemical agent [redacted]

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Moreover, we believe Iraq is conducting research into other types of chemical agents. [redacted]

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among the possibilities are soman (GD), VX or an analogue of VX, an unspecified toxin, and a psychochemical such as BZ. We do not expect Iraq to develop new agents, but to exploit the work done by the United States and the USSR. We believe, therefore, that Iraq will add additional agents to its stockpile within the next 10 years. Limited biological agent research also may be under way [redacted]

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[redacted] at both the Salman Pak and Samarra facilities. [redacted]

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Iraq also may develop alternative chemical weapon systems. In particular, the development of a rocket or missile warhead for a long-range delivery system would complement existing systems. The objective would be to extend the range of an attack past the immediate battlefield while reducing the risks associated with aircraft delivery. Iraq already has Scud surface-to-surface missiles with a range of 500 kilometers. Iraq may try to modify some of its existing Scud warheads to carry chemical weapons within the next decade [redacted]

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Implications for the United States

The success and publicity of the Iraqi chemical weapons program probably will spark "renewed determination" by Thailand, South Korea, Pakistan, and India as well as other countries to develop chemical weapons. The Iraqi experience suggests that attempts to stop a chemical weapons program once facilities are built and most major production equipment or precursor chemicals are in place will be ineffective. Moreover, controls on shipments of precursor chemicals can be circumvented if the purchaser is willing to pay prices well above market rates [redacted]

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To have stopped the Iraqi chemical weapons, it would have been necessary to take preventive action early in the process. The program probably could have been stopped in the middle 1970s when the Samarra and Salman Pak facilities were under construction. Intervention in 1981 or 1982, when the Iraqis were still acquiring the production equipment for the facilities, also might have been effective in at least slowing momentum of the program enough to prevent the establishment of the current production capability, if not the actual use of the agents against Iran. [redacted]

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The publicity that West Germany received over the association of West German private firms with the Iraqi program was instrumental in forcing Bonn and other West European governments to initiate controls. Similar publicity at an earlier stage of a chemical warfare program could play a useful role in stopping it. [redacted]

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Appendix A

Program Cost

Only some of capital expenditures for the chemical warfare effort can be estimated with confidence. Some of the costs for the production equipment are known or can be estimated, but most of the cost of the physical facilities can only be projected. Little information is available on the 10-year research and development effort, price of the precursor chemicals purchased since 1973, personnel services, support equipment, and operating costs. Insufficient information is known on the costs of special processing and support equipment such as materials used in the water treatment plant, the toxic materials disposal plant, chemical cold storage buildings, research laboratories, weapon filling lines, and special vehicles. No information is available on munition and weapon costs.

We estimate the physical facilities at the Samarra and Salman Pak sites cost over \$60 million (1983 dollars).

The value of the construction for the two Salman Pak areas is estimated at about \$19 million and for the Samarra facility at about \$43 million. The values are considered to have an error factor of plus or minus 10 percent. No projections have been made for the air defense systems now deployed around the Samarra site because these would be covered under a standard military budget, separate from the chemical warfare agent production program.

We also have identified at least \$60 million in expenditures for the production equipment installed in the Samarra and Salman Pak facilities. This probably represents only a fraction of total expenditures for

production equipment at the two facilities. The specific equipment necessary was derived from a computer methodology used to estimate chemical warfare agent production. Most of the production equipment used in the chemical warfare program has been obtained from various West European firms and represents state-of-the-art chemical engineering practices and techniques. On the basis of standard equipment costs published in US chemical engineering literature, the two mustard plants and two tabun production lines believed to be installed at the Samarra site would cost a total of about \$10 million. A security and fire protection system obtained in 1983 was valued at about \$1 million.

We estimate the minimum of 200 million US dollar equivalents includes current installation costs as well as basic requirements, such as fabrication, special engineering techniques, and quality control. The equipment used in the Samarra facility is not typical for a chemical plant, however, and probably was more expensive. Because the equipment was based on US equipment costs and because Iraqi installation cost would be different, the estimate probably has an error range of from minus 20 percent to plus 40 percent. Moreover, an early 1983 contract with a West German firm to add another mustard line and another tabun line was valued at \$40 million. This contract probably includes advance technical and consultant services, as well as ancillary materials. An equipment estimate could not be made for the production of sarin because of the lack of production capacity data.

No overall cost information is available for equipment installed at the smaller Salman Pak facility. A small mustard processing line purchased from a British company in 1973 and probably installed there cost approximately \$216,000.

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Appendix B

Comparison of the Chemical Warfare Program With Other Iraqi Military Programs

The chemical warfare program is only a small part of a much broader Iraqi military buildup that has been under way since the middle 1970s (see figure 5). After a decade of steady growth, the Iraqi Army is the largest in the Middle East, larger than the combined Armies of Egypt, Syria, Jordan, and Iraq during the 1973 Arab-Israel war. The motivations for this arms buildup are the same as for the chemical warfare program; that is, rivalries with Israel and Iran and Iraq's desire to play a leading role in the Arab world.

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At an estimated expense of \$200 million, the chemical warfare program has cost only a small portion of the approximately \$75 billion we estimate Iraq has spent on its armed forces during the past decade. Iraqi arms imports from the USSR in 1983 alone amounted to about six times the entire cost of the chemical warfare program, even when gross estimates are made for intangibles

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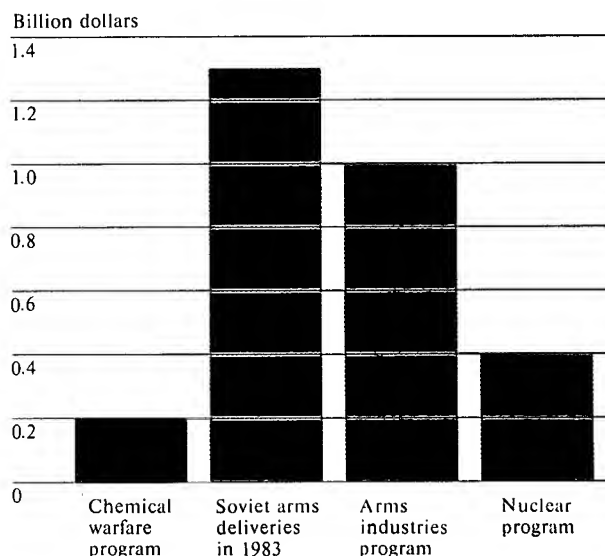
The chemical warfare program is similar to many other Iraqi military programs in its structure and mode of operation. The Iraqi military regularly makes use of numerous suppliers, both to avoid dependence on a single supplier and to circumvent controls on particular types of equipment. Also major Iraqi military programs often use government-run civilian enterprises as purchasing agents in order to avoid foreign commodity controls. The program to establish a domestic arms industry and the nuclear program both operate in this fashion

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Domestic Arms Industry

Since the middle 1970s, Iraq has invested at least a billion dollars in establishing a domestic arms industry. The effort is run by the State Organization for Technical Industries through the SAAD General Establishment. These are the same organizations responsible for managing the construction of the chemical warfare plants. Companies from at least 19 countries have been contacted or are directly involved in

Figure 5
Comparison of Costs of Iraqi Military Programs



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the Iraqi effort to establish a domestic arms industry. the West German firm responsible for setting up the chemical weapon factories, was involved in minor aspects of the Iraqi arms industry program in 1975. The main participants are Yugoslavia and an Austrian consortium

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Nuclear Program

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Approximately 100 different companies have been involved in the Iraqi nuclear program has been involved in minor aspects of the nuclear program that we estimate so far has cost Iraq at least \$400 million.

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[redacted]

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The Iraqi nuclear program is directed by the Iraqi Atomic Energy Commission, a mainly civilian organization, but is tightly controlled by the regime. At least one military officer involved in the nuclear program also was instrumental in the early 1970s in setting up the CW program [redacted]

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Like the chemical warfare program, the Iraqis have used numerous subterfuges to acquire nuclear equipment subject to supplier export controls. Iraq has used West European intermediaries and subsidiaries of US companies to procure equipment that the United States would not have supplied directly. The Iraqis also have placed orders for equipment subject to export controls in small increments that, taken individually, are not subject to regulation. [redacted]

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We also estimate that the Iraqi nuclear community has been able to add to its stock of technical knowledge and equipment by carefully exploiting training and research exchange opportunities with West European nuclear research centers. Iraqi contacts with major research centers in West Germany preceded the emergence of West German firms as Iraq's most important sources of nuclear laboratory equipment. Similar research contacts between Iraqi chemists and their counterparts in Western Europe probably are facilitating the Iraqi chemical warfare program. [redacted]

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Some observations about the Iraqi nuclear program are useful in evaluating the Iraqi chemical warfare program. First, the Iraqis identified their goal as developing an advanced nuclear program with a view toward attaining a nuclear weapons option. Next they organized management groups within the government, selected scientists and military officers for training in foreign countries, established a research and development program with the help of foreigners, and trained local technicians and engineers. They were consequently able to modify Western equipment to meet their purposes. Above all, they maintained a cover for their covert programs [redacted]

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